REMARKS

In the Final Office Action, the Examiner rejected claims 1-32. The present Response neither amends nor cancels any claims. Claims 1-32 remain pending in the present application and are believed to be in condition for allowance. In view of the following remarks, Applicants respectfully request reconsideration and allowance of all pending claims.

Claim Rejection Under 35 U.S.C. §112, First Paragraph

In the Office Action, the Examiner rejected claims 1-32 under 35 U.S.C. §112, first paragraph, for failing to comply with the enablement requirement. Applicants respectfully traverse this rejection.

Legal Precedent

Regarding the enablement requirement, the Examiner has the initial burden to establish a *reasonable basis* to question the enablement provided for the claimed invention. *In re Wright*, 999 F.2d 1557, 1562, 27 U.S.P.Q.2d 1510, 1513 (Fed. Cir. 1993). The test for enablement, as set forth by the Supreme Court, is whether the experimentation needed to practice the invention is undue or unreasonable. *Mineral Separation v. Hyde*, 242 U.S. 261, 270 (1916). A patent need not teach, and preferably omits, what is well known in the art. *In re Buchner*, 929 F.2d 660, 661, 18 U.S.P.Q.2d 1331, 1332 (Fed. Cir. 1991). The *undue experimentation* test essentially evaluates whether one of reasonable skill in the art can make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation. *U.S. v. Telectronics, Inc.*, 857 F.2d 778, 785, 8 U.S.P.Q.2d 1217, 1223 (Fed. Cir. 1988). As long as the specification discloses at least one method for making and using the claimed invention that bears a *reasonable correlation* to the entire scope of the claim, then the enablement requirement of Section 112 is satisfied. *In re Fisher*, 427 F.2d 833, 839, 166 U.S.P.Q. 18, 24 (C.C.P.A. 1970). The specification need not contain

an example if the invention is otherwise disclosed in such manner that one skilled in the art will be able to practice it without an undue amount of experimentation. *In re Borkowski*, 422 F.2d 904, 908, 164 USPQ 642, 645 (C.C.P.A. 1970).

Deficiencies of the Rejection

Independent claims 1-32 each recite the determination/extraction of one or more "motion compensation factors" which may used in the processing of image data. Particularly, the recited motion compensation factors may be used in conjunction with retrospective gating points in order to generate images having reduced motion artifacts. In rejecting independent claims 1-32 under Section 112, first paragraph, the Examiner stated:

> Claims 1-32 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claims 1-32 recite "motion compensation factors" which were not described in the disclosure in sufficient detail such that one of ordinary skill in the art would be reasonably apprised of how to use and make the claimed invention. The specification lacks any and all specific description of exactly what a motion compensation factor is, or precisely how it is derived, other than the generalized statement that the determination of the factors "may involve modeling the anticipated motion" (Specification p. 18 paragraph 3). For the purposes of further examination herein, Examiner interprets "motion compensation factor" to mean any quality or characteristic related to motion of the imaged objects.
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> Final Office Action, page 3.

As an initial matter, Applicants respectfully note that present rejection of independent claims 1-32 is essentially identical to the rejection of independent claims 1-32 under

Section 112, first paragraph, set forth in the previous Office Action mailed on August 28, 2008 ("Previous Office Action"). Applicants respectfully traverse the rejection and believe that the rejection is improper, as will be discussed further below.

As discussed in the Applicants' Response to the Previous Office Action (filed November 25, 2008), the present application clearly states that in addition to the extraction of retrospective gating points from the sensor-acquired motion data, motion compensation factors may also be extracted for image processing. *See* Application, page 18, line 24 to page 19, line 3; *see also* FIG. 4. Further, Applicants note that the present application clearly discloses that the recited motion compensation factors may be determined non-iteratively using organ motion models based on a priori data (motion is previously known) or may be extracted using iterative algorithms applied to the sensor-acquired motion data itself (e.g., motion was not previously known), and that the application of such factors may help to compensate for unwanted motion artifacts in reconstructed images of moving organs. *See id.* As such, Applicants respectfully disagree with the Examiner's general position that the specification fails to provide a description of how motion compensation factors are derived. Indeed, based on at least these teachings, Applicants respectfully assert that one of ordinary skill in the art would be able to practice the image processing techniques described in the present application without undue experimentation and, thus, independent claims 1-32 satisfy the enablement requirement under Section 112, first paragraph. *Mineral Separation v. Hyde*, 242 U.S. 261, 270 (1916); *see also U.S. v. Telectronics, Inc.*, 857 F.2d 778, 785, 8 U.S.P.Q.2d 1217, 1223 (Fed. Cir. 1988).

In the Final Office Action, the Examiner continued to assert that the recited "motion compensation factors" of claims 1-32 are "not such a standard element known in the art such that one of ordinary skill would be reasonably apprised of what Applicant considers to be such a factor conceived of within the present invention, nor would one of

ordinary skill in the art be reasonably apprised of how to derive or acquire such a factor." Final Office Action, page 5. The Examiner further stated that "Applicant could not possibly have conceived of and successfully used with the present invention each and every possible quality or characteristic related to motion of the imaged objects." *Id.* at page 6. Applicants respectfully disagree with this line of reasoning.

First, with regard to the Examiner's assertions that Applicants did not contemplate *every* possible type of motion compensation factor, Applicants stress that the former Court of Customs and Patent Appeals has made it clear that the "specification need not contain an example if the invention is otherwise disclosed in such manner that one skilled in the art will be able to practice it without an undue amount of experimentation." *In re Borkowski*, 422 F.2d 904, 908, 164 USPQ 642, 645 (C.C.P.A. 1970) (emphasis added). With these legal guidelines in mind, Applicants note that the Examiner failed to offer any evidence, in either the Previous Office Action or the present Final Office Action, to support an assertion that one of ordinary skill in the art would be burdened by undue experimentation when attempting to utilize motion compensation factors in conjunction with retrospective gating in practicing the image processing techniques set forth in Applicants' disclosure. Still further, as discussed above, Applicants provided at least one example in the specification of motion compensation factors that may be determined based on previously known organ motion data (e.g., a priori data in the form of an organ motion model). Thus, although Applicants may not have necessarily discussed *every* possible type of motion compensation factor that may be utilized, it is believed that the example(s) provided in the specification are clearly sufficient to enable one skilled in the art to understand how to apply motion compensation factors in conjunction with retrospective gating.

Second, with regard to the Examiner's continued assertion that those skilled in the art would *not* be reasonably apprised of what constitutes a motion compensation factor, Applicants again stress that there is simply no basis for such an assertion. To the contrary, Applicants believe that those skilled in the art that routinely practice the art of medical imaging will regularly encounter challenges in producing an image of a *moving* organ that is free of or contains relatively few motion-related artifacts. Accordingly, those skilled in the art will readily appreciate that if the motion of the moving organ is already known (e.g., a priori data from organ motion models) or may be anticipated (e.g., using iterative motion algorithms), then such motion may be compensated for, thus preventing or substantially reducing the occurrence/appearance of unwanted motion artifacts in a resulting reconstructed image. In other words, it is believed that those skilled in the art having the benefit of the present disclosure will readily appreciate that various motion compensation factors could be utilized in processing image data pertaining to a particular organ to generate images having reduced motion artifacts.

Accordingly, because the Examiner has failed to provide a convincing line of reasoning as to why one skilled in the art would not understand what constitutes a "motion compensation factor," and because the Examiner has failed to provide evidence that the utilization of motion compensation factors in the imaging techniques recited by claims 1-32 would require undue experimentation, Applicants respectfully submit that the rejection of claims 1-32 under Section 112, first paragraph, is improper. For at least the reasons discussed above, Applicants respectfully request withdrawal of the rejection of independent claims 1-32 under 35 U.S.C. § 112, first paragraph.

Claim Rejections Under 35 U.S.C. §103

In the Office Action, the Examiner rejected claims 1-8 under 35 U.S.C. §103(a) as being unpatentable over *PC-Based System for Retrospective Cardiac and Respiratory Gating of NMR Data*, by Bohning et al. (hereinafter "the Bohning reference") in view of

Subject-Specific Motion Correction Factors for Magnetic Resonance Coronary Angiography, by Keegan et al. (hereinafter "the Keegan reference"). The Examiner also rejected claims 9-32 under 35 U.S.C. §103(a) as being unpatentable over the Bohning reference in view of the Keegan reference, and further in view of Rogers, U.S. Patent No. 5,477,144 (hereinafter "the Rogers reference"). Applicants respectfully traverse these rejections.

Legal Precedent

The burden of establishing a prima facie case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (PTO Bd. App. 1979). In addressing obviousness determinations under 35 U.S.C. §103, the Supreme Court in *KSR International Co. v. Teleflex Inc.*, 127 S. Ct. 1727 (2007), reaffirmed many of its precedents relating to obviousness including its holding in *Graham v. John Deere Co.*, 383 U.S. 1 (1966). In *KSR*, the Court also reaffirmed that "a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *Id.* at 1741. In this regard, the *KSR* court stated that "it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does ... because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." *Id.* Furthermore, the *KSR* court did not diminish the requirement for objective evidence of obviousness. *Id.* ("To facilitate review, this analysis should be made explicit. See *In re Kahn*, 441 F.3d 977, 988 (CA Fed. 2006) ("[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness")). As our precedents make clear, however, the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the

inferences and creative steps that a person of ordinary skill in the art would employ."); *see also In re Lee*, 61 U.S.P.Q.2d 1430, 1436 (Fed. Cir. 2002) (holding that the factual inquiry whether to combine references must be thorough and searching, and that it must be based on *objective evidence* of record).

Further, when prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988). One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). The Federal Circuit has warned that the Examiner must not, "fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher." *In re Dembiczak*, F.3d 994, 999, 50 U.S.P.Q.2d 52 (Fed. Cir. 1999) (quoting *W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1553, 220 U.S.P.Q. 303, 313 (Fed. Cir. 1983)).

Additionally, Applicants note that it is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 U.S.P.Q. 769, 779 (Fed. Cir. 1983); M.P.E.P. §2145. Moreover, if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious. *In re Ratti*, 270 F.2d 810, 123 U.S.P.Q. 349 (CCPA 1959); see M.P.E.P. §2143.01(VI). If the proposed modification or combination would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed

modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984); see M.P.E.P. §2143.01(V).

The combination of the Bohning and Keegan references is improper to support the rejection of Independent Claims 1-32.

As discussed above, each of independent claims 1-32 recites the determination and/or extraction of one or more "motion compensation factors" which may used in the processing of image data. In the Final Office Action, the Examiner admitted that the Bohning reference fails to disclose the recited motion compensation factors and, therefore, cited the Keegan reference to remedy these deficiencies. As will be discussed below, Applicants do not believe that there is any objective motivation for combining the Bohning and Keegan references in the manner suggested by the Examiner. Particularly, each reference appears to adequately address the issue of motion-related artifacts in medical imaging, and thus do not appear to be amenable to the modifications suggested by the Examiner.

For example, the Bohning reference appears to disclose that respiratory and cardiac imaging using nuclear magnetic resonance (NMR) techniques is often subjected to unwanted motion-related artifacts due at least partially to the generally constant motion of the cardiac and respiratory organs while image acquisition is occurring. *See* Bohning, page 303. Particularly, the Bohning reference notes that NMR image acquisition acquired in typical single-slice multiphase acquisitions are subject to several inherent problems. *See id.* at 304. One such problem relates not only to the motion of the heart, but also the nonconstant (e.g., changing) rate of the heartbeat (e.g., a patient's heart rate may change over time), which may ultimately result in non-uniform R-R intervals in an electrocardiograph (ECG) trace. As explained by the Bohning reference, nonconstant R-R intervals may result in unequal signal recovery between multiphase sets and incorrect phasing of the data acquisition, which may result in increased image noise, motion

artifacts, and image blurring, all of which may degrade the resulting images and impair a physician's ability to make a proper diagnosis. *See id.*

To address these drawbacks, the Bohning reference discloses a technique referred to as "clustering," which uses stored ECG timing to adjust NMR cardiac data phasing based upon the inherent irregularities in the heart's movements, rather than attempting to impose regular NMR measurements. *See id.* at pages 306-307. For instance, "clustering," as described by the Bohning reference, involves determining an appropriate cardio-respiratory time cluster for each NMR measurement profile and rearranging the serially collected raw data *into-time clustered sets*, wherein each set corresponds to a particular area of a normalized C-R plane. *See id.* at page 311. In other words, as best understood by Applicants, the Bohning reference solves motion-related problems in NMR imaging by "binning" or classifying acquired image data based upon a corresponding phase within an R-R interval at which the data is acquired, such that the image data associated with a particular "cluster" all generally corresponds to the same phase of the cardiac cycle.

With these points in mind, Applicants note that the Keegan reference, which was cited by the Examiner in combination with the Bohning reference, addresses what appears to be a similar issue, i.e., image acquisition of a moving organ, but by a different means. Instead of using a "clustering" or binning technique, as described in the Bohning reference, the Keegan reference appears to discuss the use of motion correction factors that may be derived based upon the motions of the heart and the diaphragm in three orthogonal directions. *See* Keegan, page 67. In particular, motion in the head-foot (HF) direction, the anterior-posterior (AP) direction, and the left-right (LR) direction may be measured and subsequently used to assess the motion of the heart as a function of diaphragm position. *See id.* at pages 67-68. The Keegan reference further notes that, based on this data, correction factors may be calculated for each of the three orthogonal

directions as a ratio of the FH, AP, and LR displacements of the coronary artery between inspiratory and expiratory scans to that of the dome of the right hemi-diaphragm. *See id.* at page 68. Accordingly, these correction factors may be utilized to compensate for motion during imaging and, thus, reduce or prevent the occurrence of motion-related artifacts.

With the above discussion in mind, Applicants note that the Keegan reference essentially addresses the same problem set forth in the Bohning reference, but in the completely different manner. To summarize, the Bohning reference solves imaging problems relating to motion by acquiring a set of data, and then binning or "clustering" the data into different groups based upon, for example, a corresponding phase within an R-R interval at which the data is acquired. For example, cardiac data acquired over one R-R interval may be binned into different groups based on the various cardiac phases that occur within an R-R interval. In other words, motion, in accordance with the teachings of Bohning, is not "corrected" based upon correction factors. Rather, the data is arranged such that all data corresponding to the same phase of a motion cycle is grouped together, thus effectively "masking" motion-related artifacts. The Keegan reference, in contrast, does not bin or cluster the image data, but instead determines correction factors in one or more orthogonal directions in order to compensate for motion that occurs during image acquisition. However, because both the Bohning and Keegan references appear to adequately address the issue of motion during image acquisition, there appears to be no objective basis for modifying the Bohning reference as suggested by the Examiner.

Further, even assuming that the "correction factors" discussed in the Keegan reference could be considered analogous to the recited "motion compensation factors" of claims 1-32, the Examiner's stated motivation to modify the Bohning reference, i.e., to calculate a motion compensation factor and to process images according to such a factor, appears to be entirely baseless, as the problems relating to motion artifacts in the Bohning

reference are *already* addressed by using the above-discussed image clustering techniques. *See* Final Office Action, page 3. In other words, because the Bohning reference indicates that the disclosed image clustering techniques adequately solves motion-related issues during imaging, one skilled in the art would find no need to further modify the Bohning reference to further address motion-related issues, nor has the Examiner provided any reasonable objective basis as to why one skilled in the art would want to further modify the Bohning reference to essentially solve a problem that has *already* been solved. Instead, Applicants believe that the motivation proffered by the Examiner appears to be nothing more than a pretext for an unneeded modification to the Bohning reference solely to justify the present rejection, i.e., the motivation appears to be based solely on the improper use of hindsight. Such a motivation is clearly not objective nor is it based on the teachings demonstrated in the art.

Thus, given the absence of an objective motivation to combine the Bohning and Keegan references, Applicants respectfully submit that no *prima facie* case of obviousness is believed to exist with respect to independent claims 1-32 of the present application. Accordingly, the Applicants respectfully request withdrawal of the present rejection and allowance of the present claims.

The combination of the Bohning, Keegan, and Rogers references fails to teach or suggest the use of electrical and non-electrical sensors concurrently, as recited by independent claims 9-16 and 25-32.

Even assuming hypothetically that the Examiner's combination of the Keegan and Bohning references is proper, Applicants do not believe that the Keegan and Bohning reference teach every element recited by independent claims 9-16 and 25-32 when further combined with the Rogers reference. For instance, independent claims 9-16 and 25-32 are directed towards various methods and systems, as well as computer readable media storing a computer program, all of which reflect various embodiments of the present invention. Applicants note, however, that claims 9-16 each commonly recite the

acquisition of motion data for a respiratory organ (e.g., a lung) using both electrical *and* non-electrical sensors. Similarly, claims 25-32 each commonly recite the acquisition of motion data for a heart using both electrical *and* non-electrical sensors. In other words, claims 9-16 and claims 25-32 recite the concurrent use of both electrical *and* non-electrical sensors. After careful review, Applicants do not believe that the cited references, either alone or in combination, teaches the use of electrical *and* non-electrical sensors concurrently.

In the Final Office Action, the Examiner acknowledged that the Bohning and Keegan references disclose electrical sensors, but not the use of non-electrical sensors. The Examiner then cited the Rogers reference to purportedly remedy this deficiency. Although the Rogers reference does appear to mention that non-electrical sensors (e.g., pressure transducers, acoustic microphones, etc.) may be used during image acquisition, it appears that the Rogers reference mentions non-electrical sensors as being an *alternative* to electrical sensors. For instance, the primary embodiment shown in FIG. 4 of the Rogers reference provides an electrocardiogram (ECG – an electrical sensor) to acquire cardiac motion data. The Rogers reference appears to indicate that cardiac motion data is not limited to being measured by an ECG, but may be measured by "any suitable means" including a pressure transducer, an acoustic microphone, a piezoelectric crystal transducer, strain gauges, or air flow meters. *See* Rogers, col. 5, lines 53-63. In other words, the Rogers reference appears to suggest these additional types of electrical/non-electrical sensors as being *alternatives* to an ECG. Applicants are unable to locate any teaching or suggestion, however, that the Rogers reference discloses that non-electrical sensors are used *concurrently* with electrical sensors. Thus, when combined with the Keegan and/or Bohning references, the Rogers reference appears to merely suggest that the electrical sensors disclosed in the Keegan and Bohning references may be replaced with non-electrical sensors. However, there does not appear to be any indication that the

cited references, in combination, teach the use of electrical *and* non-electrical sensors concurrently, as generally recited by independent claims 9-16 and 25-32.

In view of these deficiencies, among others, no *prima facie* case of obviousness is believed to exist with regard to independent claims 9-16 and 25-32 based upon the Bohning, Keegan, and Rogers references. As such, Applicants respectfully request that the Examiner withdraw the Section 103 rejection and allow independent claims 9-16 and 25-32.

Claim Rejections under Doctrine of Obviousness-Type Double Patenting

In the Final Office Action, the Examiner provisionally rejected claims 1-16 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-8 and 17-24 of co-pending Application No. 10/723,857. *See* Final Office Action, page 5. The Examiner also provisionally rejected claims 17-32 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 17-32 of co-pending Application No. 10/732,857 in view of the Rogers reference. *See id.* Although Applicants do not necessarily agree that the present claims 1-16 are obvious over claims 1-8 and 17-24 of co-pending Application No. 10/723,857, or that the present claims 17-32 are obvious over claims 17-32 of co-pending Application No. 10/732,857 and the Rogers reference, Applicants are willing to file a terminal disclaimer, if necessary, when the present claims are indicated as allowable. Accordingly, Applicants respectfully request that the Examiner hold the obviousness-type double patenting rejection in abeyance until the present claims are indicated as allowable.

Conclusion

In view of the remarks and amendments set forth above, Applicants respectfully request allowance of the pending claims. If the Examiner believes that a telephonic interview will help speed this application toward issuance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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